TANGO®+

SERVICE MANUAL

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Part # 80-0002-01 REV A

MANUAL CONTENTS

SECTION 1	**Introduction**	**3**
SECTION 2	**Tango+ Inputs & Outputs**	**4**
	Inputs	**4**
	Outputs	**4**
	Combined Inputs & Outputs	**4**
SECTION 3	**Operation Modes & Menu System**	**5**
	Normal Operation	**5**
	Maintenance Menu	**5**
SECTION 4	**Routine Maintenance**	**7**
	Verification of Calibration	**8**
	Pressure Calibration	**9**
	Leak Rate Test	**10**
	Timeout Check	**11**
	Overpressure Check	**12**
SECTION 5	**Non-Routine Maintenance**	**13**
	General Internal Inspection	**13**
	Pneumatic Inspection	**14**
	Clock Battery Replacement	**14**
SECTION 6	**Disassembly & Re-assembly Procedures**	**15**
Appendix 1	**Spare Parts List**	**17**
Appendix 2	**Tango+ Exploded View (Front)**	**18**
Appendix 3	**Tango+ Exploded View (Rear)**	**19**
Appendix 4	**Key to Exploded Views**	**20**
Appendix 5	**Tango+ Main PCB Schematics**	**21**
Appendix 6	**Tango+ Pump & Valve PCB Schematics**	**33**
Appendix 7	**Tango+ Internal ECG PCB Schematics**	**34**

TANGO+ STRESS TEST BLOOD PRESSURE MONITOR

1.0 INTRODUCTION

1.1 The SunTech Medical Tango+ Stress Blood Pressure Monitor is used to monitor blood pressure and heart rate during exercise testing. The Tango+ can be used as a stand alone monitor, or in conjunction with a host Stress Test system. The Tango+ consists of a Base unit, Pneumatic/K-Sound Patient Cable, and cuff.

1.2 The Tango+ is normally interfaced to a host stress test system and receives its analog or digital ECG trigger via a coaxial BNC connection. There is an optional internal ECG board available for stand alone operation.

2.0 TANGO+ INPUTS & OUTPUTS

2.1 TANGO+ INPUTS

2.1.1 Reset Switch, located on rear of enclosure. Operation causes a hard reset of all microprocessors in the Tango+.

2.1.2 External (Analog or Digital) ECG Trigger Input. Provides the ECG signal to the Tango+ from a host Stress Test system.

2.1.3 Optional ECG Patient Cable (3 lead to 6-pin DIN). Provides the ECG signal to the Tango+. Used only if the Tango+ is not using an external ECG source.

2.1.4 Front Panel Keypad. Five key membrane pad used to control the Tango+ operations.

2.1.5 +9.0 volt medical grade power supply, SunTech 19-0011-00.

2.2 TANGO+ OUTPUTS

2.2.1 Cold cathode backlit LCD display.

2.2.2 Beeper (for audible feedback).

2.3 TANGO+ COMBINED INPUTS & OUTPUTS

2.3.1 Pneumatic / K-Sound Patient Cable. Connects the Tango+ pneumatic pump to the arm cuff, and the Tango+ K-Sound circuitry to the K-Sound microphone.

2.3.2 9-Pin Bi-directional Serial Port. Used for communicating with the host system.

3.0 OPERATIONAL MODES & MENU SYSTEM DESCRIPTION

3.1 Normal Operation - The Tango+ is a menu-driven system. All programming and operations are controlled by using the front panel keypad. The Tango+ program prompts the user when input is required, and provides instructions (via the LCD) for what should be done. Refer to the Tango+ User's Manual for detailed instructions on using the system under normal operational conditions.

3.2 Maintenance Menu - Certain maintenance operations may be accessed by a hidden key sequence that is not normally available to the user. The Maintenance Menu is accessed by the following keypad input sequence:

1. Push and hold the MENU key down.
2. Push the UP arrow key and release.
3. Push the DOWN arrow key and release.
4. Release the Menu key.

The available options are shown on-screen and are more fully discussed in the following sections.

In addition to the options used by the standard maintenance procedures (described later in this manual), the Maintenance Menu also provides access to the Configuration Options settings, Usage Statistics reports and Direct Hardware Control:-

3.2.1 Configuration Options:-

1. "Bin Skip" Configuration. This setting is used to help determine the K-sound window for analysis. This value is normally set to 3 when the ECG trigger is set to Digital. The value is set to 0 when the ECG trigger is set to Analog. **Note: Any change in this value can cause incorrect detection of K-sounds.**
2. "ECG Delay" Configuration. This value is normally set to 0ms. This setting is used to compensate for any time delay the host stress test system might induce in the ECG trigger. **Note: Any change in this value can cause incorrect detection of K-sounds.**
3. "MAP Display" Configuration. This is normally set to "OFF" for units that are sold in the USA. The value is set to "ON" for non domestic units.
4. "Dia Tail Thresh" Configuration. This value is normally set to 10. Used to help determine blood pressure when Diastolic Tail is present.

3.2.2 Usage Statistics

1. “Diagnostic Counts”. This menu item holds the total BP Count and total Power Time. The Burn Time is usually at a value of 0.

2. “Calibration Counts”. After approximately one year of use, the Tango+ will display a calibration required message upon boot-up. Once the calibration has been verified, the “UP” arrow is pushed and the count is reset allowing another full year of use. This is a calibration reminder for the end user. Pressing the “DOWN” arrow sets the BP count to 350 and the date to the current date. This will cause the Tango+ to display the calibration required message the next time it boots-up.

3.2.3 Direct Hardware Control

1. “Test Hardware”.
   a) Pump (On/Off): turns the pumps on or off.
   b) Valve (Closed/Open): close or open the dump valve. Note that the valve state displayed in the menu is the state that the valve will change to if you “Enter” the menu item, not the state that the valve is currently in.
   c) Bleed Valve (0-255): 0 = fully open, 1 to 255 = fully closed. UP/DOWN arrows increment/decrement the value by one.
   d) Beeper (On/Off): turns the beeper on or off.
   e) Test Serial Port: selecting this menu entry causes the monitor to send the string “Testing <linefeed><carriage return>” out of the serial port using the currently selected stress system protocol.

2. “Test Input Channels”. This option is provided for SunTech use only.

3. “Bootload”. This option is provided for SunTech use only.

4.0 TANGO+ ROUTINE MAINTENANCE PROCEDURES

4.1 The following standard maintenance procedures are provided to ensure correct calibration of the Tango+ and correct operation of the basic patient safety systems of the Tango+. SunTech recommends that the calibration and safety systems are checked annually.

4.1.1 VERIFICATION OF PRESSURE CALIBRATION

Equipment Required:-

1. Calibrated electronic manometer.
2. 500ml volume.
3. Hand Inflation Bulb with bleed valve.
4. Tubing, Tee pieces and miscellaneous connectors.

4.1.1.1 To perform a Calibration Verification, proceed as follows:-

4.1.1.2 Tee the manometer, the 500ml volume and the inflation bulb together and connect to the patient cable hose connection.

4.1.1.3 Select the "Verify Calibration" screen by the following keypad input sequence:

1. Press the MENU key.
2. Select "Monitor Setup".
3. Select "Verify Calibration".

The Tango+ will now have its valves closed and will display on its screen the pressure applied to the patient hose connector.

4.1.1.4 Verify the Tango+ calibration by inflating manually and checking the manometer against the pressure reading on the Tango+ display. Verify the readings as shown in Table 1:-

Pressure (mm Hg on Manometer)	Pressure (mm Hg as read by UUT)
0	0 - 1
50	48 - 52
100	98 - 102
150	148 - 152
200	198 - 202
250	248 - 252
280 (note)	278 - 282

Table 1: Pressure Verification Table

Note – Increase pressure to 280mmHg slowly, to avoid overshoot tripping the overpressure limit.

4.1.1.5 Press "ENTER" (MENU key) to open the valves and release the pressure from the system.

4.1.1.6 Reset the Tango+ (using the Reset slide switch on the rear of the enclosure).

4.1.2 PRESSURE CALIBRATION

Equipment Required:-

1. Calibrated electronic manometer
2. 500ml volume
3. Hand Inflation Bulb with bleed valve
4. Tubing, Tee pieces and miscellaneous connectors

4.1.2.1 To perform a Pressure Calibration, proceed as follows:-

4.1.2.2 Tee the manometer, the 500ml volume and the inflation bulb together and connect to the patient cable hose connection.

4.1.2.3 Access the maintenance menu by the following keypad input sequence:

1. Push and hold the MENU key down.
2. Push the UP arrow key and release.
3. Push the DOWN arrow key and release.
4. Release the Menu key.

Select Calibrate from the Maintenance Menu.

4.1.2.4 As prompted by the LCD, open the bleed valve on the pneumatic bulb to obtain 0mmHg pressure, then press ENTER (MENU key) to set the zero point into the Tango+.

4.1.2.5 Close the bleed valve on the bulb and inflate to 250mmHg. Allow the pressure to stabilize, readjusting as necessary to maintain the pressure at 250mmHg.

4.1.2.6 Press ENTER (MENU key) to set the 250mmHg point into the Tango+.

4.1.2.7 Reset the Calibration Counter (follow instructions in Section 3.2.2).

4.1.2.8 Reset the Tango+ (using the Reset slide switch on the rear of the enclosure).

4.1.2.9 Calibration is now complete, but should be verified as detailed above.

4.1.3 LEAK RATE TEST

Equipment Required:-

1. Stop Watch.
2. 500ml volume.
3. Hand Inflation Bulb with bleed valve.
4. Tubing, Tee pieces and miscellaneous connectors.

4.1.3.1 To perform a Leak Rate test, proceed as follows:-

4.1.3.2 Tee the 500ml volume and the inflation bulb together and connect to the patient cable hose connection.

4.1.3.3 Select the "Verify Calibration" screen by the following keypad input sequence:

1. Press the MENU key.
2. Select "Monitor Setup".
3. Select "Verify Calibration".

The Tango+ will now have its valves closed and will display on its screen the pressure applied to the patient hose connector.

4.1.3.4 Inflate the pressure to 250mm Hg. Allow the system to stabilize for 1 minute, re-adjusting to 250mm if required. Note the exact pressure, and simultaneously start the stop-watch. After a further 60 seconds delay, the pressure should not have dropped by more than 2mmHg.

4.1.3.5 Press "ENTER" (MENU key) to open the valves and release the pressure from the system.

4.1.3.6 Reset the Tango+ (using the Reset slide switch on the rear of the enclosure).

4.1.4 TIMEOUT CHECK

Equipment Required:-

1. Stop Watch.
2. 500ml volume.
3. Hand Inflation Bulb with bleed valve.
4. Tubing, Tee pieces and miscellaneous connectors.

4.1.4.1 To perform a Timeout Test, proceed as follows:-

4.1.4.2 Tee the 500ml volume and the inflation bulb together and connect to the patient cable hose connection.

4.1.4.3 Select the "Verify Calibration" screen by the following keypad input sequence:

1. Press the MENU key.
2. Select "Monitor Setup".
3. Select "Verify Calibration".

The Tango+ will now have its valves closed and will display on its screen the pressure applied to the patient hose connector.

4.1.4.4 Have the stop watch ready, and rapidly pressurize the system to approximately 200mmHg. When passing the 10mmHg mark, start the stopwatch. Wait for the Tango+ to release the pressure, and stop the stopwatch as the pressure falls back through the 10mmHg point. The time must be between 160 and 180 seconds.

4.1.4.5 Reset the Tango+ (using the Reset slide switch on the rear of the enclosure).

4.1.5 OVERPRESSURE CHECK

Equipment Required:-

1. 500ml volume
2. Hand Inflation Bulb with bleed valve
3. Tubing, Tee pieces and miscellaneous connectors

4.1.5.1 To perform an Overpressure Test, proceed as follows:-

4.1.5.2 Tee the 500ml volume and the inflation bulb together and connect to the patient cable hose connection.

4.1.5.3 Select the "Verify Calibration" screen by the following keypad input sequence:

1. Press the MENU key.
2. Select "Monitor Setup".
3. Select "Verify Calibration".

The Tango+ will now have its valves closed and will display on its screen the pressure applied to the patient hose connector.

4.1.5.4 Using the inflation bulb, apply 280mmHg pressure. Then slowly continue to inflate the system until the UUT opens the valves and releases the pressure. This must occur between 290mmHg and 320mmHg.

4.1.5.5 Reset the Tango+ (using the Reset slide switch on the rear of the enclosure).

5.0 TANGO+ NON-ROUTINE MAINTENANCE PROCEDURES

5.0.1 Internal Maintenance

WARNING – When powered, hazardous voltages exist on the Tango+ main circuit board, in the vicinity of the backlight connector and backlight generator (center of the bottom edge of the pcb). To avoid risk of electrical shock, do not power the Tango+ main circuit board when any part of the enclosure has been removed.

5.0.2 Other than the Clock Battery, there are no user serviceable parts within the Tango+. However, the enclosure may be removed and the circuit boards separated if it is required to inspect the unit for mechanical damage (eg for liquid ingress after spillage, or if the unit has been dropped).

5.1 General Internal Inspection

5.1.1 Open up the enclosure, then remove and separate the circuit boards as described in Section 6.

5.1.2 Inspect each board for damage or contamination. Should any damage or liquid contamination be evident, the Tango+ should be re-assembled and returned to SunTech for board replacement and full re-test. Any dry contamination (eg dust, or small objects that may have fallen through the grill) may be removed, using a brush or gentle compressed air.

5.1.3 Re-fit the boards in the front half of the Enclosure.

5.1.4 Inspect the pneumatics as described in Section 5.2.

5.1.5 Re-fit the rear enclosure as described in Section 6.

5.1.6 Perform both a Leak Rate test and a Timeout Test (as described in Section 4) to verify that the pneumatic system is functioning correctly.

5.2 Pneumatic Inspection

5.2.1 Open up and remove the rear enclosure as described in Section 6.

5.2.2 Carefully inspect all pneumatic connections, checking that the tubing is fully pushed over the corresponding nipples or manifold connections.

5.2.3 Carefully check the condition of all tubing for damage or kinking.

5.2.4 Re-fit the rear enclosure as described in Section 6.

5.2.5 Perform both a Leak Rate test and a Timeout Test (as described in Section 4) to verify that the pneumatic system is working correctly.

5.3 Clock Battery Replacement

5.3.1 Should the internal clock start losing time, or the clock stop completely, the clock battery must be changed, as follows:-

5.3.2 Open up the enclosure, and then remove the Pump & Valve board from the Main Board as described in Section 6.

5.3.3 Identify the Clock Battery (silver coin sized disc in a black plastic holder) labeled “B1” on the main circuit board.

5.3.4 Gently ease up the battery retaining spring lever until the battery can be extracted by sliding sideways towards the top edge of the circuit board.

5.3.5 Fit the new battery (SunTech part number 17-0012-00) by sliding it under the retaining clip until it clips securely into the plastic battery holder.

5.3.6 Re-fit the Pump & Valve board and rear enclosure as described in Section 6.

5.3.7 Perform both a Leak Rate test and a Timeout Test (as described in Section 4) to verify that the pneumatic system has not been disturbed.

5.3.8 The clock must now be set to the current time, as described in the Tango+ Operating Manual.

5.3.9 Recycle or dispose of the old battery in accordance with local regulations.

6.0 Disassembly and Re-assembly

WARNING – When powered, hazardous voltages exist on the Tango+ main circuit board, in the vicinity of the backlight connector and backlight generator (center of the bottom edge of the pcb). To avoid risk of electrical shock, do not power the Tango+ main circuit board when any part of the enclosure has been removed.

6.1 Place the Tango+ display downwards on a soft surface.

6.2 Remove the four case screws (located on rear panel at each corner).

6.3 Carefully separate the back cover from the front cover. Then carefully remove the pneumatic hose connection from the patient cable hose connection. Note: If the optional internal ECG board is installed, remove the connection from the internal ECG board to cable running to the connector on the back panel.

6.4 If required, the Pump & Valve pcb may be separated from the main pcb at this stage. Remove the five fixing nuts and lock washers from the top of the five supporting spacers. Make a mental note of the tube routing before lifting the Pump & Valve pcb away from the support spacers, taking care not to bend or damage the electrical connection pins at J1. Gently pull the tubing off the transducer connection nipples, and then the Pump & Valve board may be completely removed.

6.5 If required, the optional Internal ECG board may be removed from the main board at this stage. Using pliers, carefully squeeze together the top of each of the four nylon support pillars in turn, and ease the Internal ECG board over the end of each pillar. Take care not to damage the connection with the main board, or any of the components. Lay the Internal ECG board to one side.

6.6 The main Tango+ circuit board may be removed either with or without the prior removal of the Pump & Valve board and the optional Internal ECG board. To remove the Tango+ board from the enclosure front, the two screws holding the board into the enclosure must first be removed. These screws are located approximately centrally along each of the longer edges of the circuit board. The board may then be carefully lifted from the front enclosure, ensuring that the Keypad Tail is disconnected from the circuit board at J15 when this becomes accessible (J15 is located on the main display side of the circuit board).

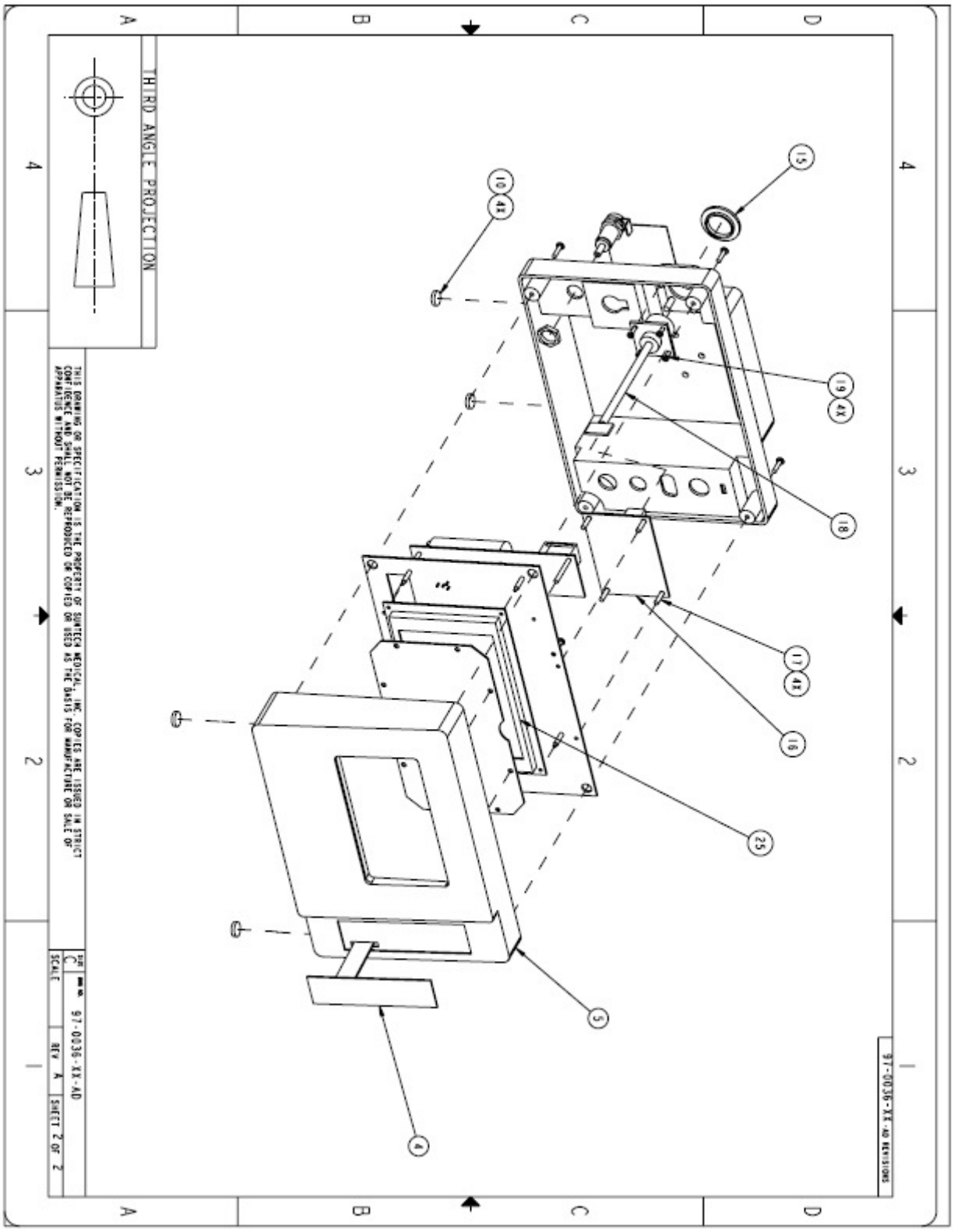
6.7 Refitting of boards is the reverse procedure to disassembly. Take particular care to ensure the correct insertion of the headers connecting the boards, especially the header connecting the main board to the pump and valve board. The pneumatic tubing must be arranged in the same positions as noted before disassembly. When closing the enclosure, the tubing to the patient hose connection should loop through the large slot in the main circuit board to prevent it from kinking.

6.8 After re-assembly both the Leak Test and Timeout Test (as described in Section 4) should be performed to ensure that all tubing has been correctly reconnected and has not been kinked.

APPENDIX 1 TANGO+ SPARE PARTS LIST

PART NUMBER	DESCRIPTION
91-0001-00	Patient Cable, 15’
98-0008-00	Pole Clamp Assy.
98-0062-05	Adult Plus Cuff
92-0038-01	Tango+ Complete Mother board
92-0001-00	Tango+ ECG Board
91-0004-00	Tango+ ECG Cable
58-0003-02	Tango+ Keypad
19-0011-00	9V Power Supply
32-0001-00	Overlay, Clear, LCD
97-0022-01	Pump, P05K
55-0093-00	Valve (control)
55-0043-05	Valve (dump)
17-0012-00	Battery, Lithium
39-0001-03	Enclosure, Tango+, Front, Screen Printed SunTech
39-0002-13	Enclosure, Tango+, Rear, Printed

APPENDIX 2 TANGO+ EXPLODED VIEW (FRONT)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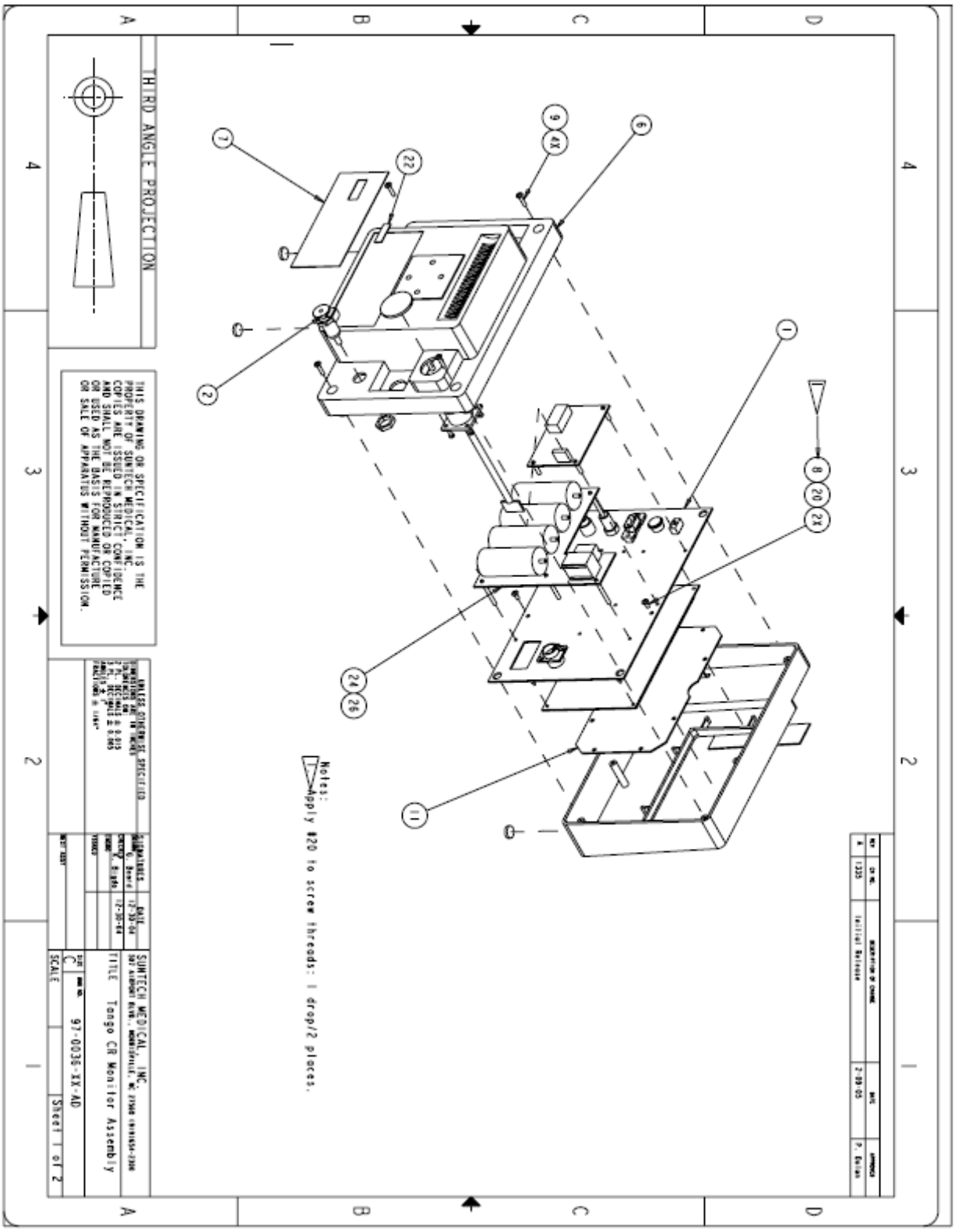
SIZE C
SCALE
97-0036-XX-AD
REV A
SHEET 2 OF 2
97-0036-XX-AD REVISIONS

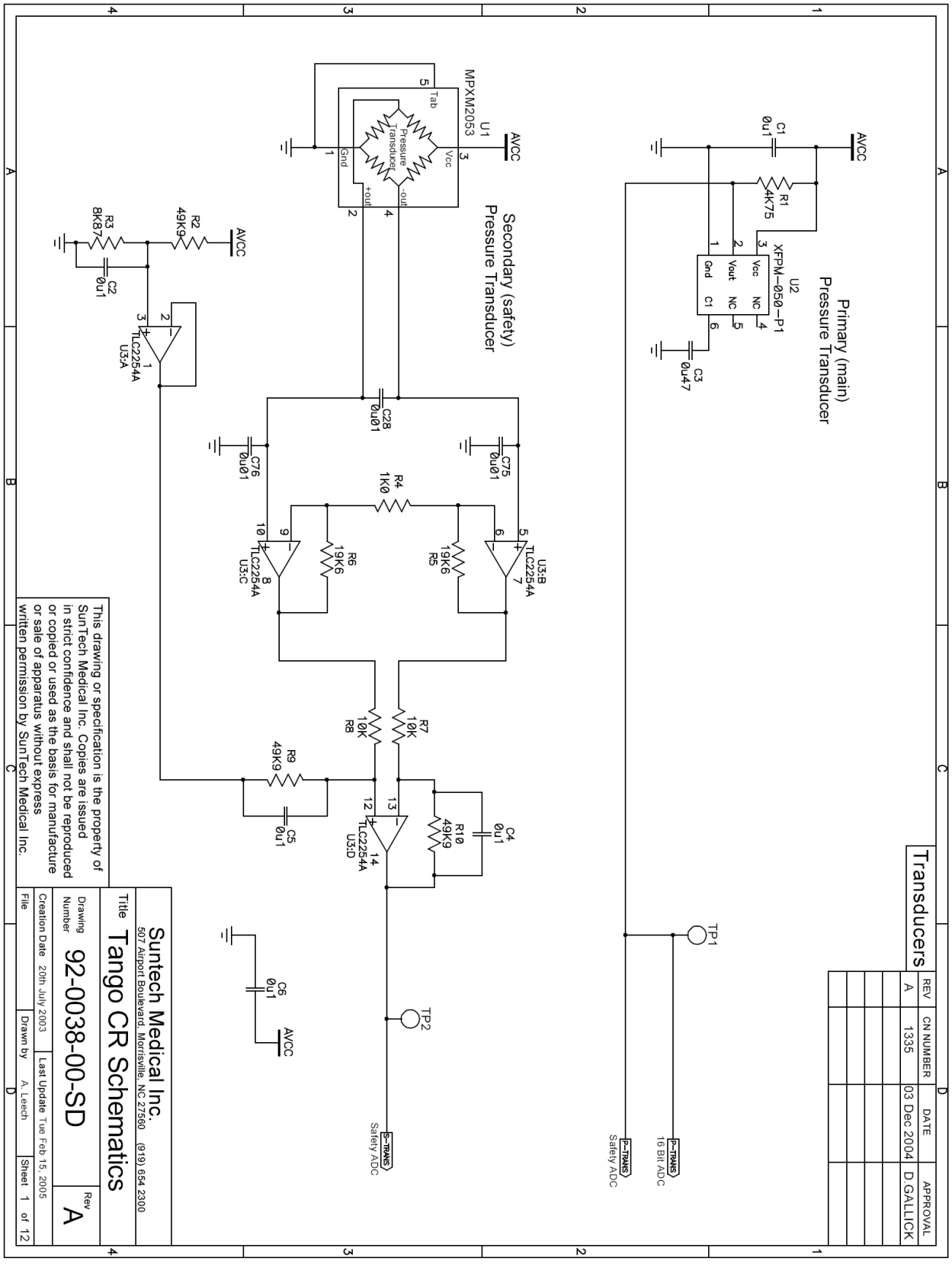
APPENDIX 3 TANGO+ EXPLODED VIEW (REAR)



APPENDIX 4 KEY TO EXPLODED VIEWS

Drawing Reference (97-0036-XX-AD)	Quantity	Part Description	SunTech Part Number
1	1	Main Circuit Board Assembly	92-0038-01
2	1	Patient Hose Connector, female, locking	55-0009-00
4	1	Keypad, 5 button	58-0003-02
5	1	Tango+ Front Enclosure	39-0001-03
6	1	Tango+ Rear Enclosure	39-0002-13
7	1	Label, Tango+ Rear, English	71-0001-00
8	2	Screw, 4/40 x 1/4” Pan head Phillips	40-0006-00
9	4	Screw, 4/40 x 3/8” Pan head Phillips	40-0012-00
10	4	Rubber foot	42-0001-00
11	1	LCD Lens Cover	32-0001-00
15	1	Hole plug, black	42-0002-00
16	1	Tango+ Internal ECG PWA Assembly	92-0001-00
17	4	Support Post, 0.5” Nylon	41-0003-00
18	1	Cable, for Internal ECG PWA Assembly	91-0002-00
19	4	Screw, Plastite, Phillips	40-0009-00
20	A/R	Adhesive, Loctite #242	70-0003-00
22	1	Label, serial number bar code	72-0001-01
24	1	Pump & Valve Circuit Board Assembly	92-0042-00
25	1	LCD Panel	26-0005-00
26	1	Pneumatic Manifold Assembly	97-0034-00

APPENDIX 5 TANGO+ MAIN PCB SCHEMATICS (Sheet 1)



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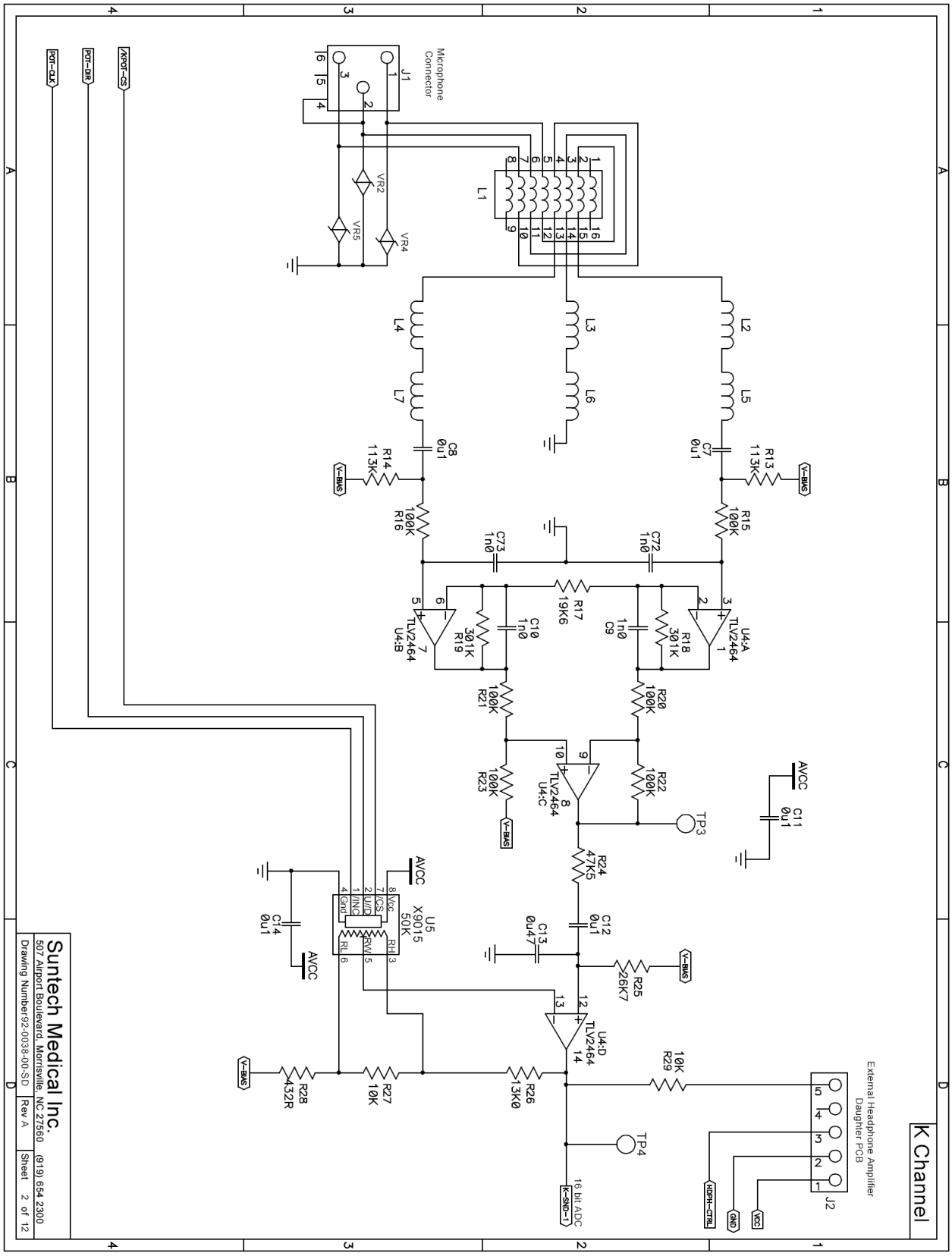

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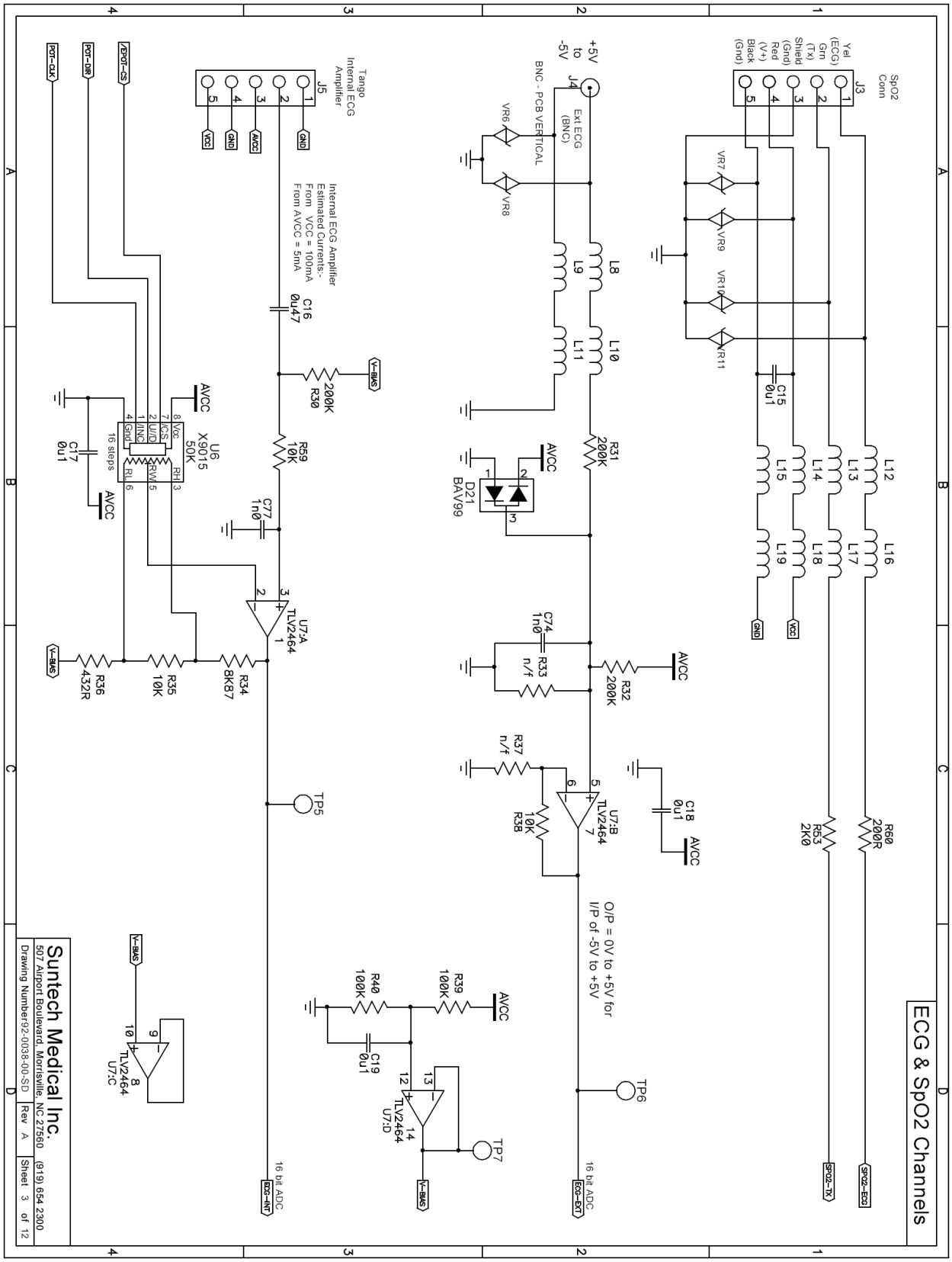

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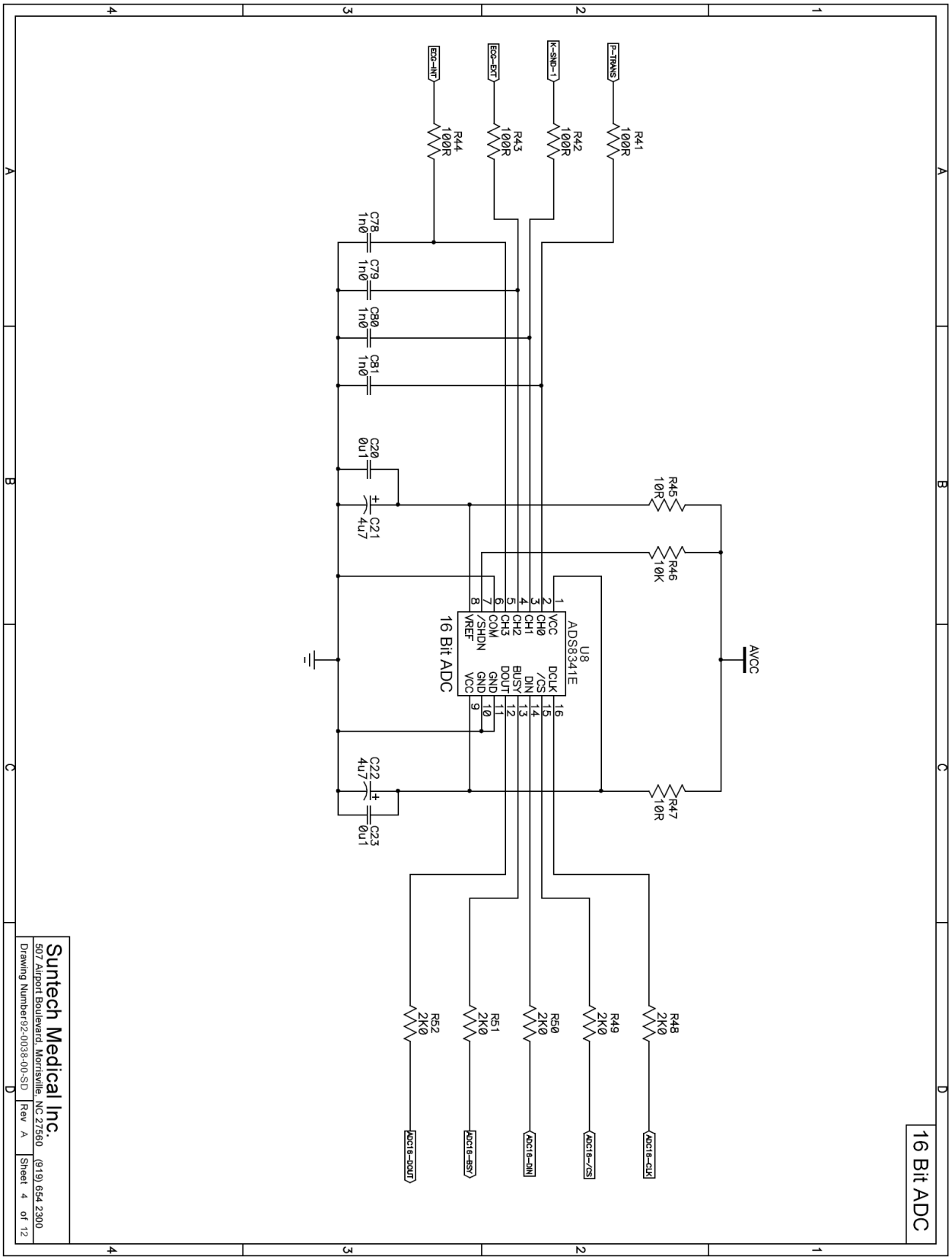
507 Airport Boulevard Morrisville, NC 27560 (919) 654 2300
Drawing Number92-0038-00-SD Rev A Sheet 3 of 12

APPENDIX 5 TANGO+ MAIN PCB SCHEMATICS (Sheet 4)



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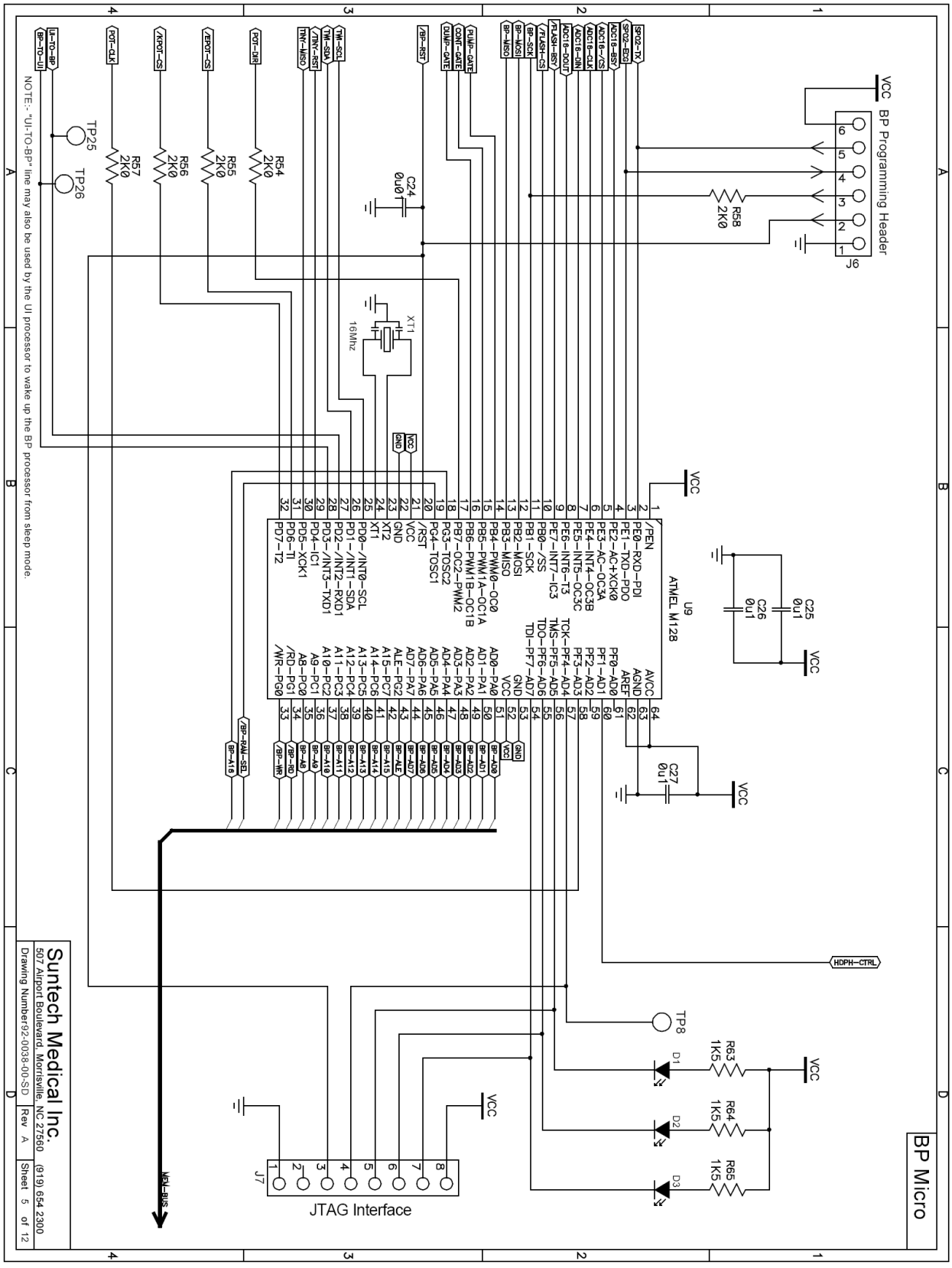

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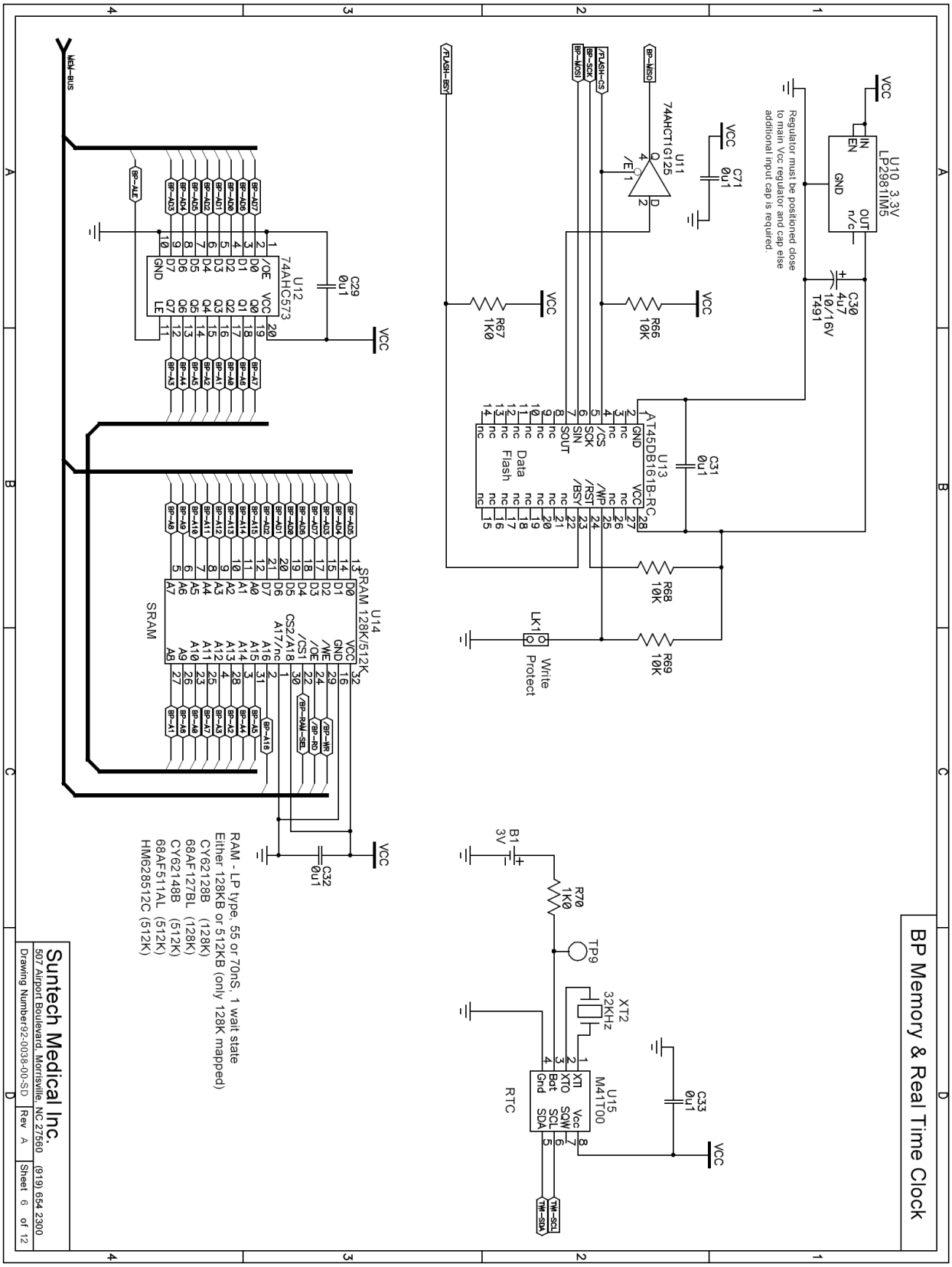

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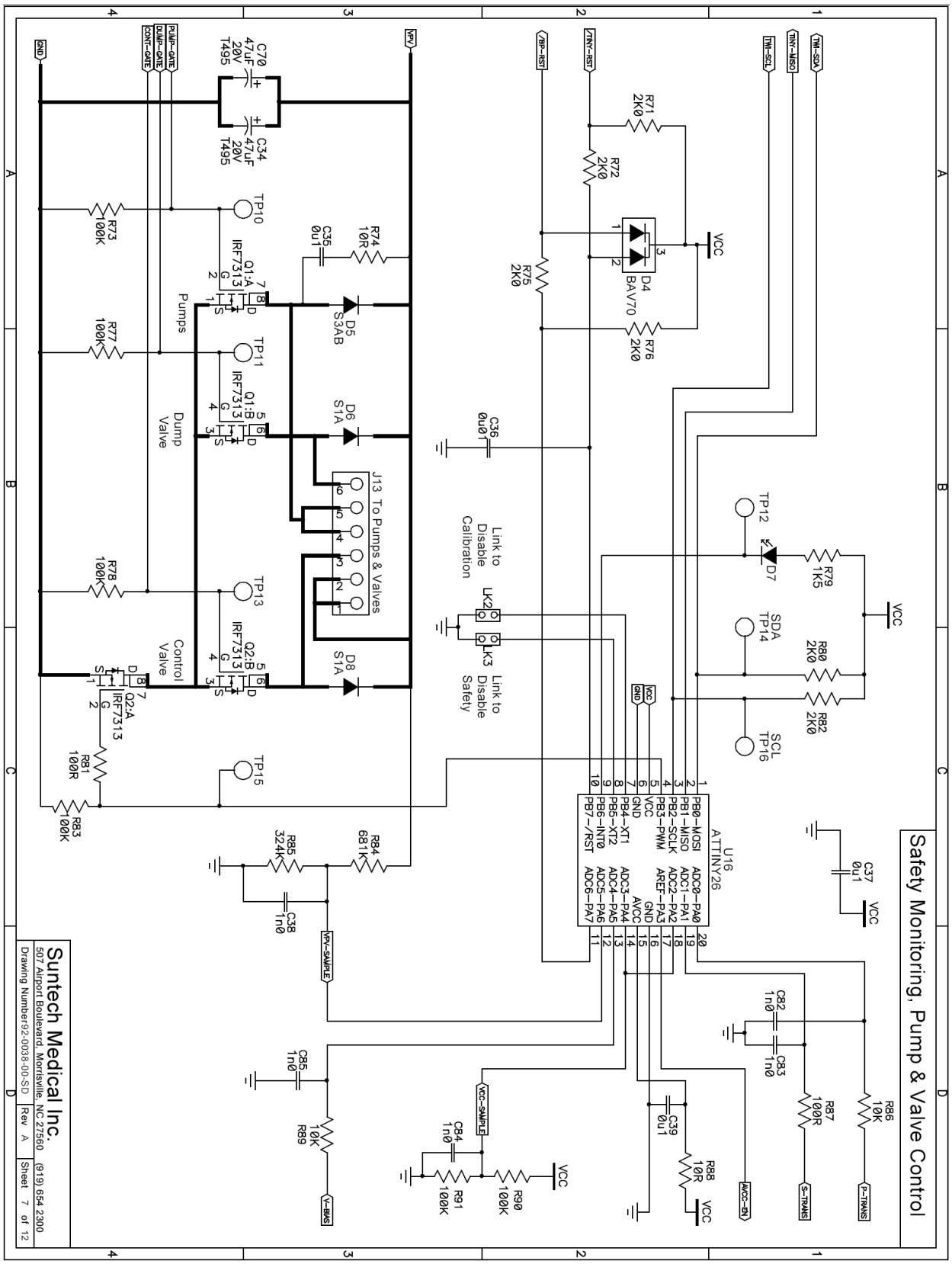
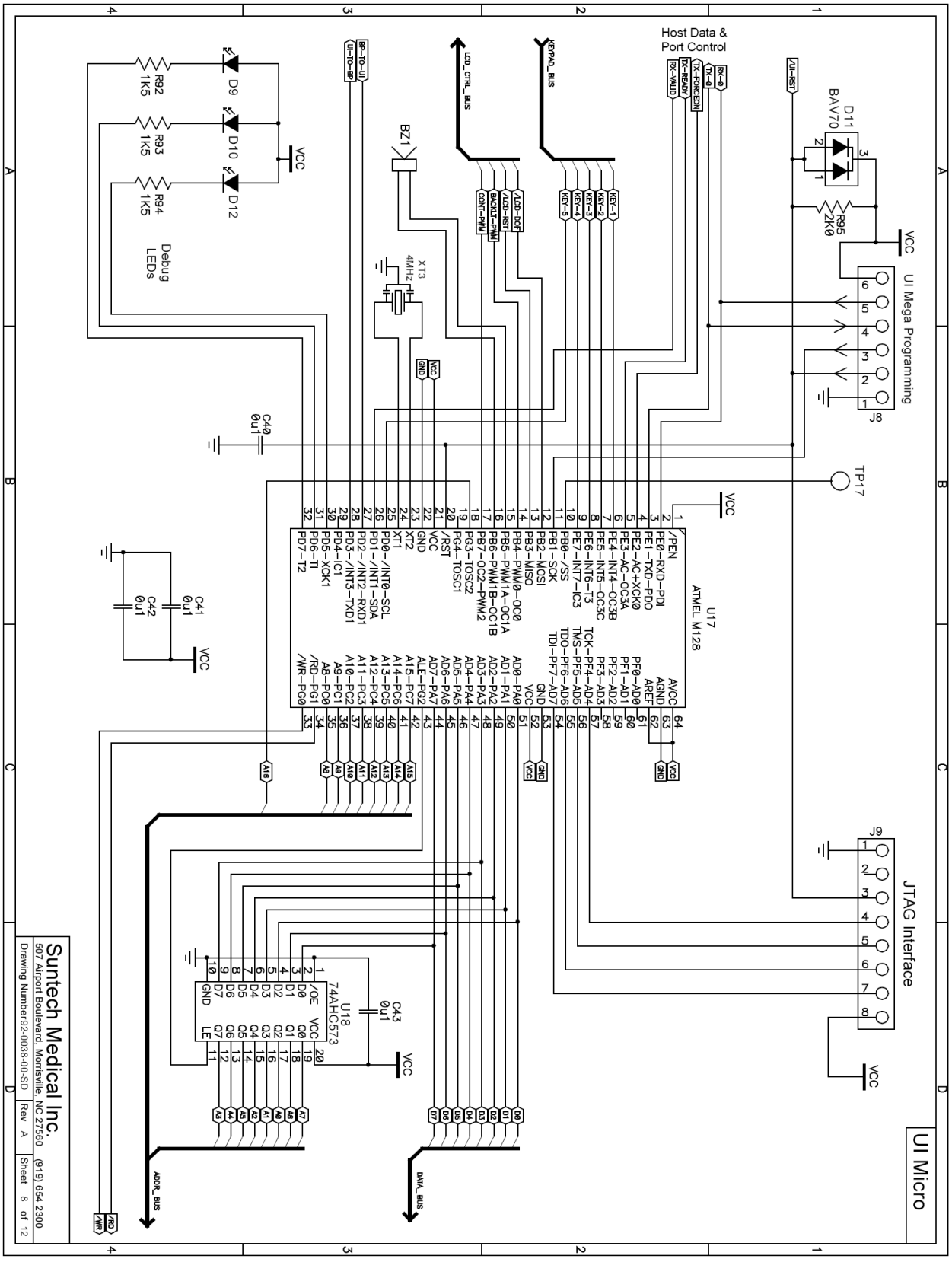


APPENDIX 5 TANGO+ MAIN PCB SCHEMATICS (Sheet 8)



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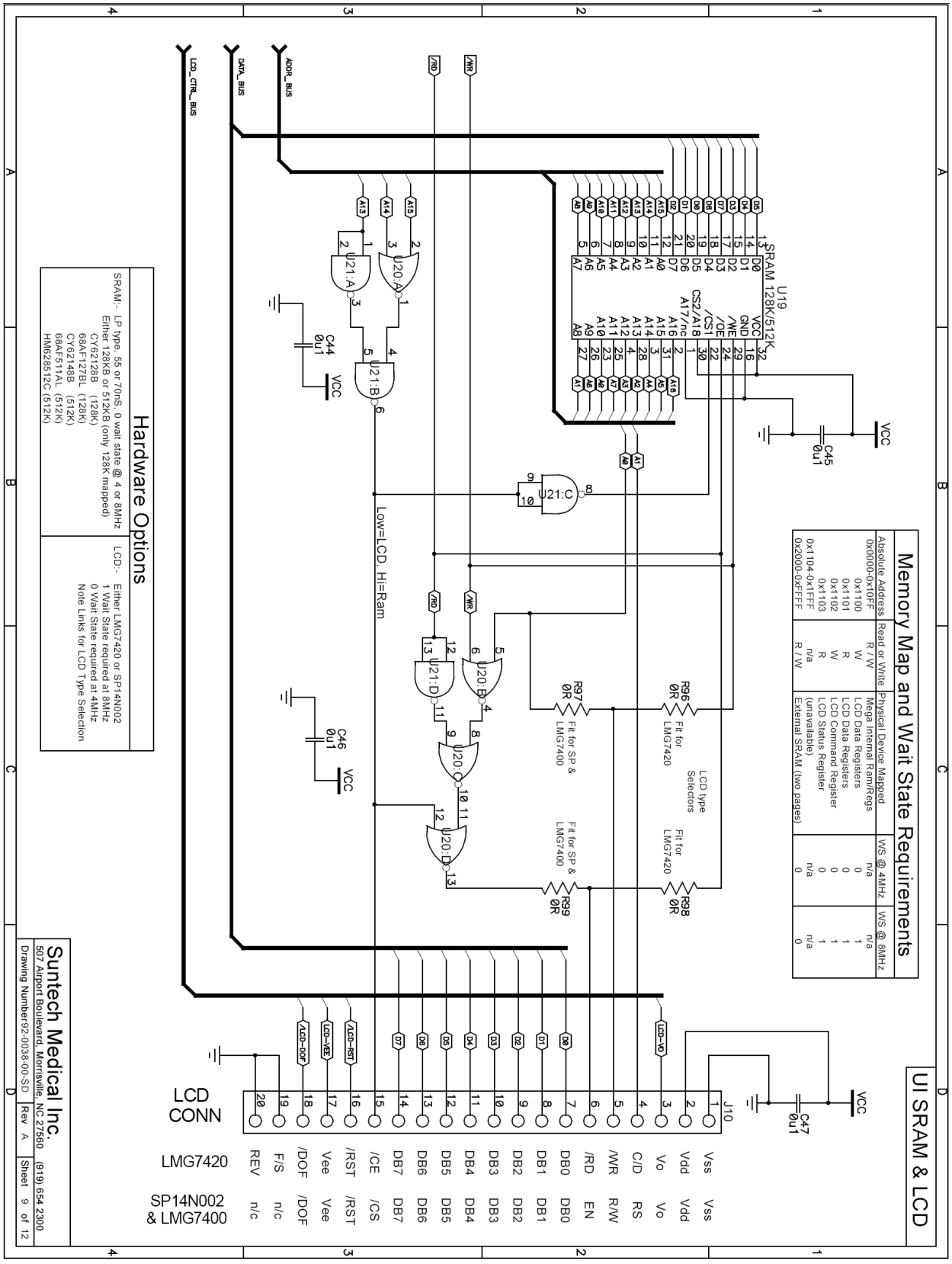
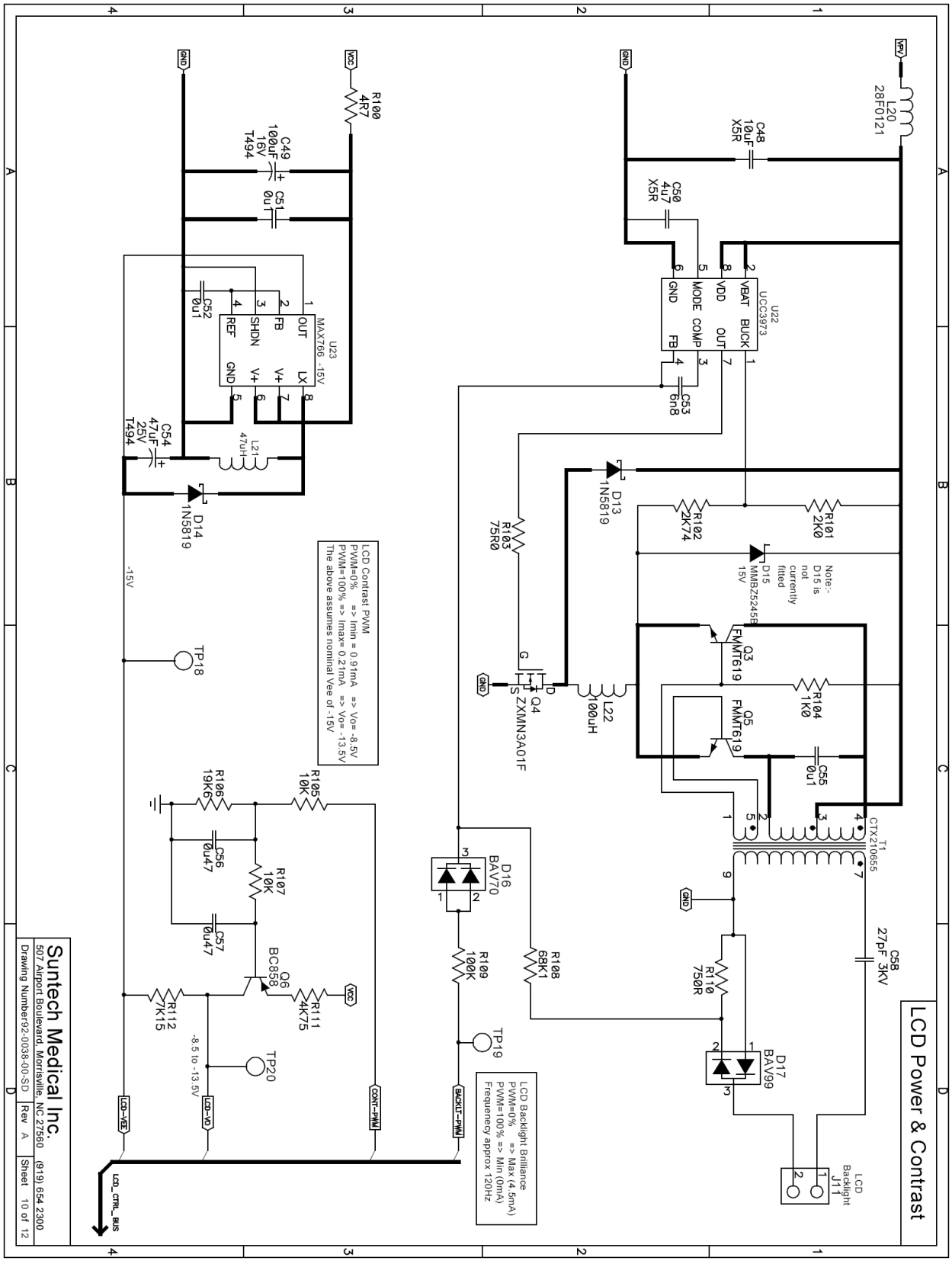
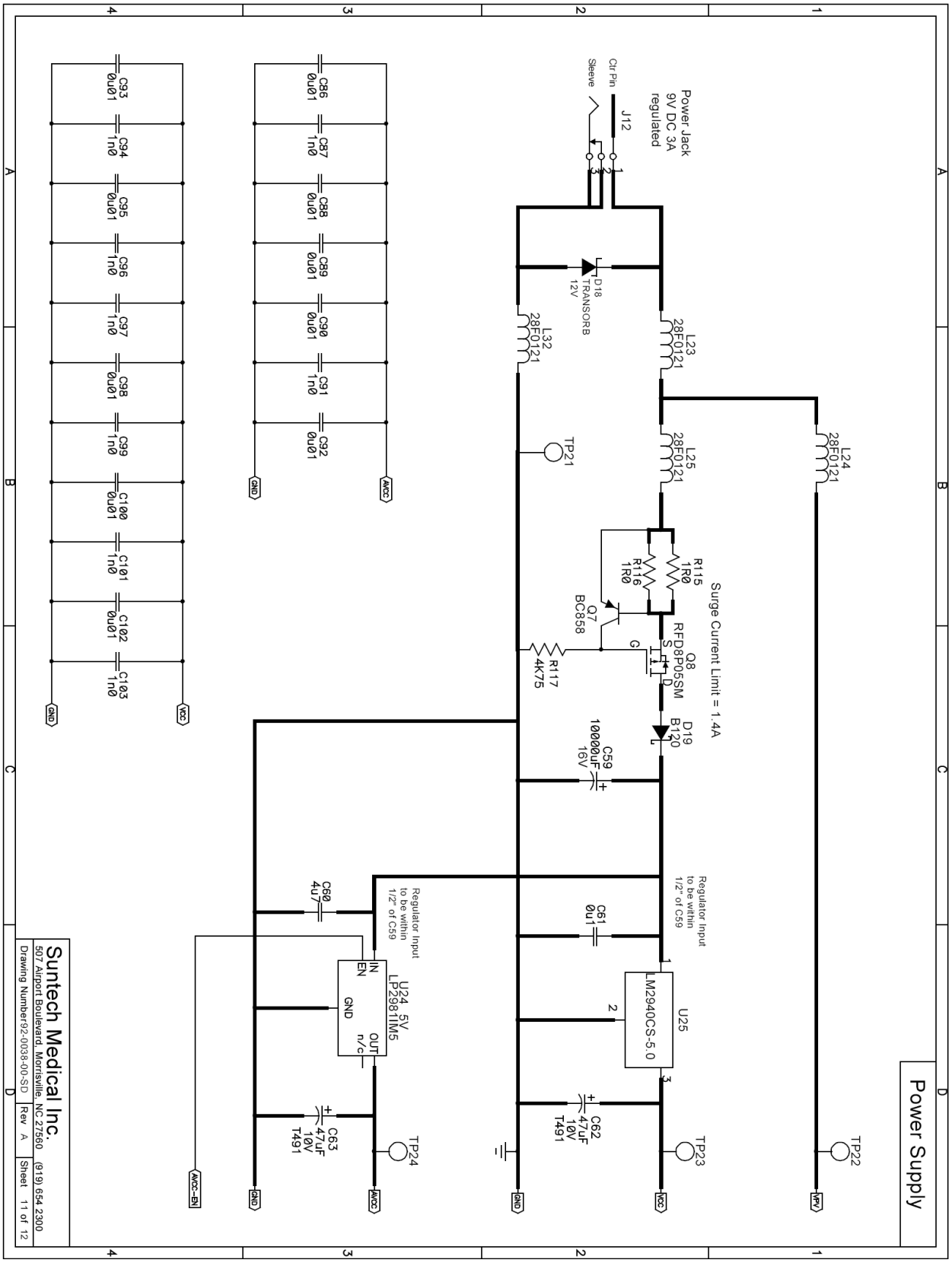


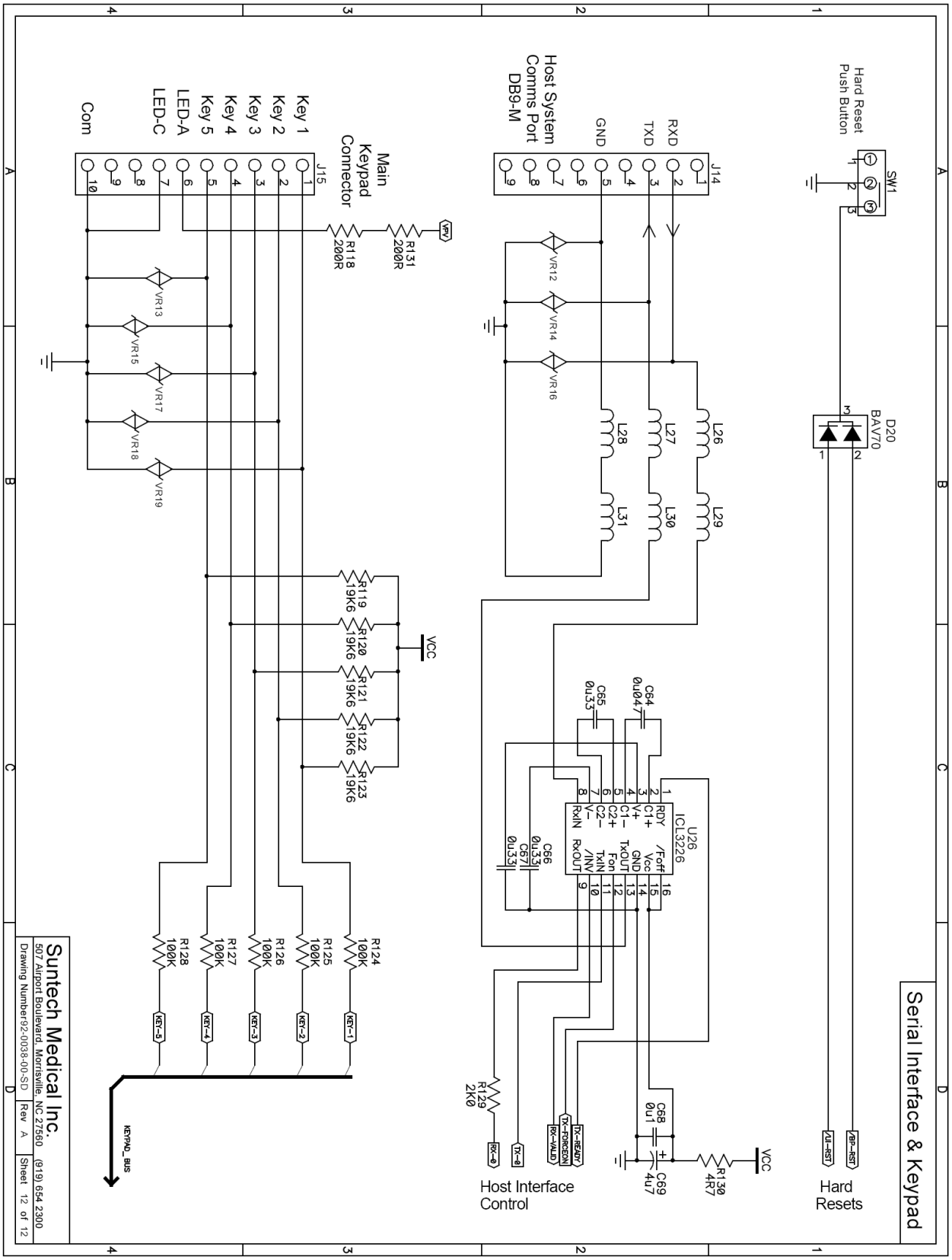
APPENDIX 5 TANGO+ MAIN PCB SCHEMATICS (Sheet 10)


LCD Power & Contrast
Suntech Medical Inc.
507 Airport Boulevard Morrisville, NC 27560 (919) 654 2300
Drawing Number 92-0038-00-SD Rev A Sheet 10 of 12
LCD Contrast PWM
PWM=0% => Imin = 0.91mA => Vo= -8.5V
PWM=100% => Imax= 0.21mA => Vo= -13.5V
The above assumes nominal Vee of -15V
LCD Backlight Brilliance
PWM=0% => Max (4.5mA)
PWM=100% => Min (0mA)
Frequency approx 120Hz
Note:- D15 is not currently fitted
-15V
-8.5 to -13.5V
LCD_CTRL_BUS

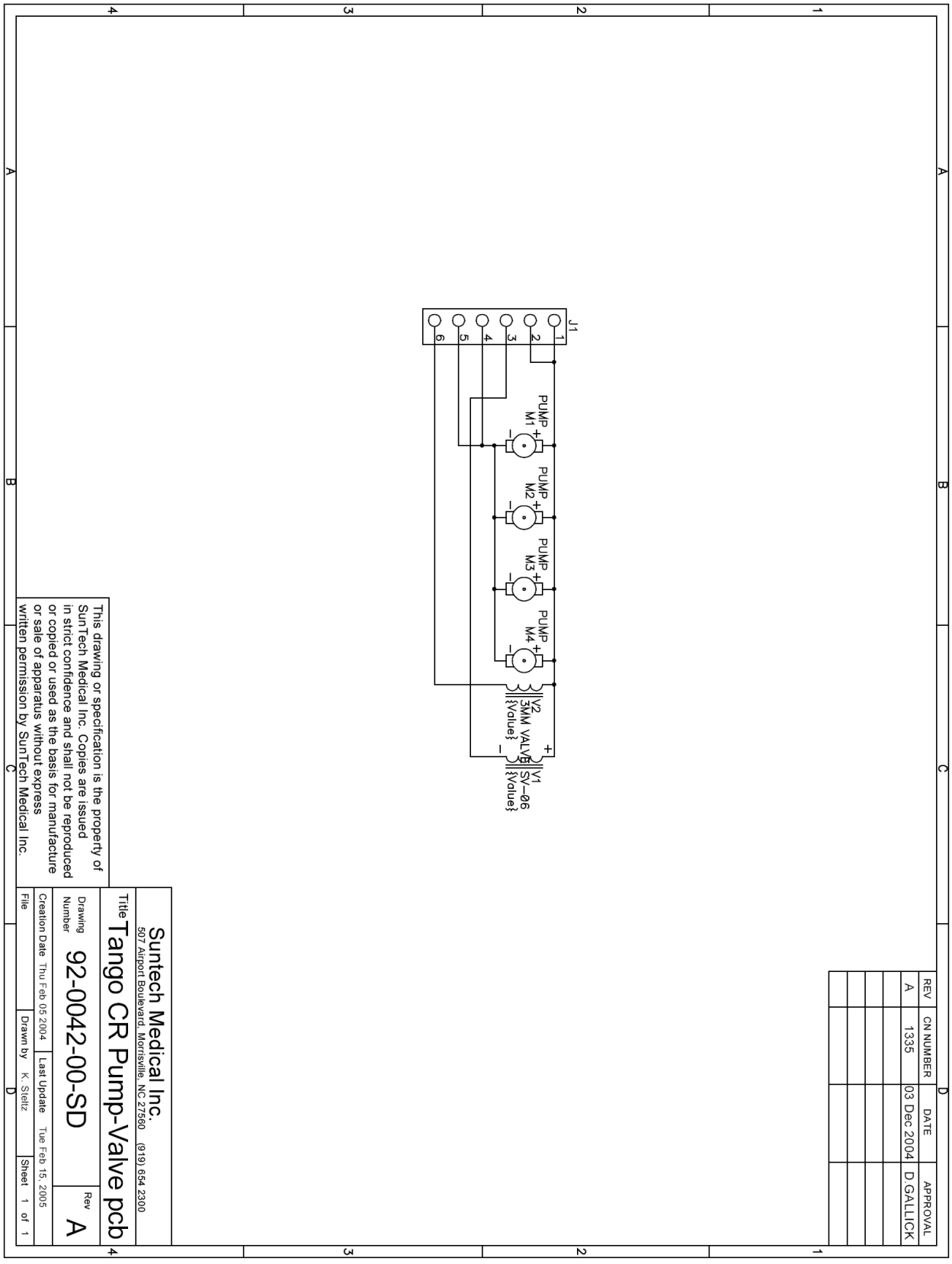
APPENDIX 5 TANGO+ MAIN PCB SCHEMATICS (Sheet 11)



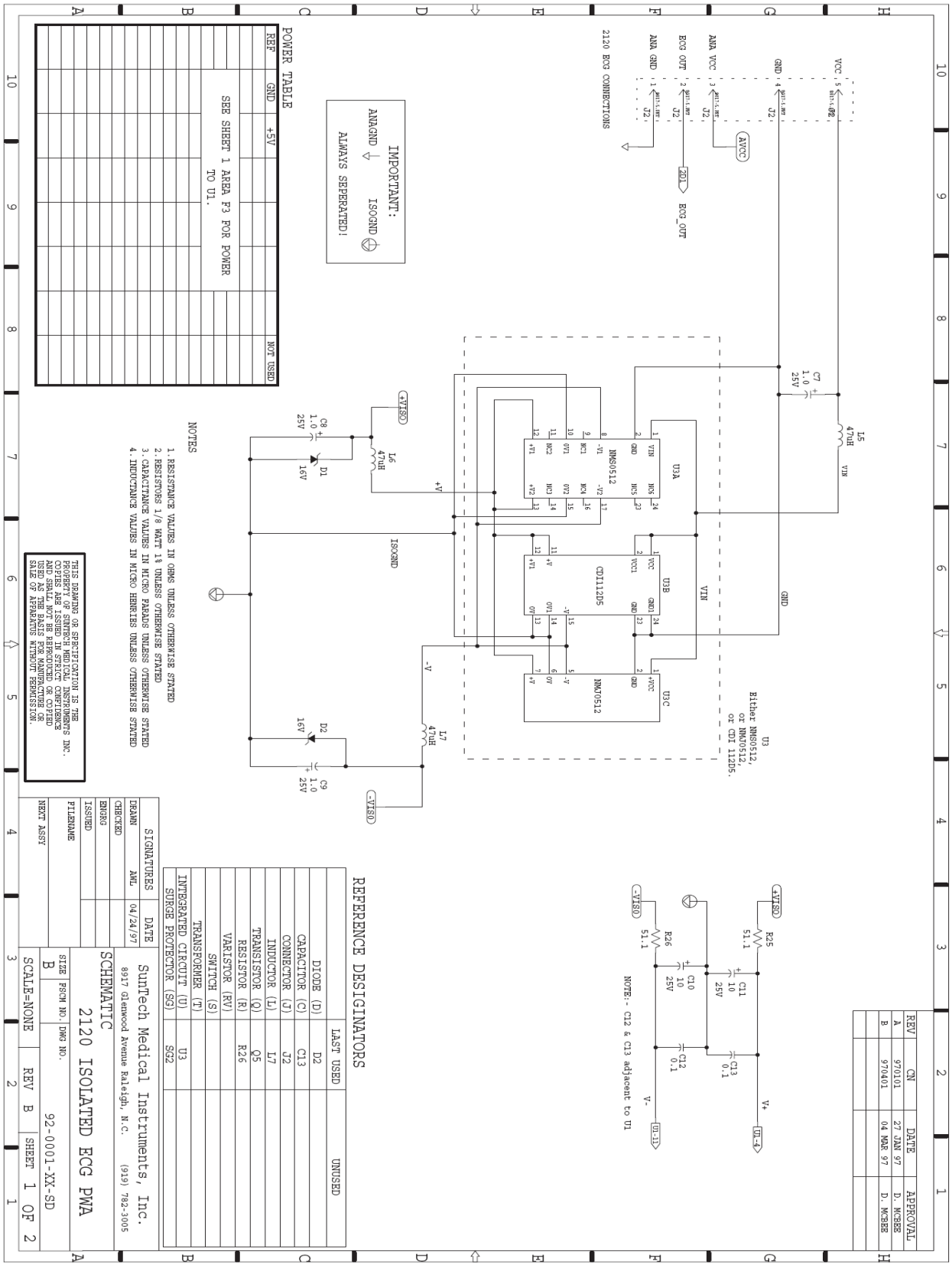
APPENDIX 5 TANGO+ MAIN PCB SCHEMATICS (Sheet 12)



APPENDIX 6 TANGO+ PUMP & VALVE PCB SCHEMATICS



APPENDIX 7 TANGO+ INTERNAL ECG PCB SCHEMATICS (Sheet 1)


2120 ECG CONNECTIONS
ECG_OUT
IMPORTANT:
ANAGND ISOGND
ALWAYS SEPERATED!
SEE SHEET 1 AREA F3 FOR POWER TO U1.
POWER TABLE
REF GND +5V NOT USED
NOTES
1. RESISTANCE VALUES IN OHMS UNLESS OTHERWISE STATED
2. RESISTORS 1/8 WATT 1% UNLESS OTHERWISE STATED
3. CAPACITANCE VALUES IN MICRO FARADS UNLESS OTHERWISE STATED
4. INDUCTANCE VALUES IN MICRO HENRIES UNLESS OTHERWISE STATED
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U3 Either NM80512, or NMJ0512, or CDI 112D5.
NOTE:- C12 & C13 adjacent to U1
REFERENCE DESIGNATORS
DIODE (D) D2
CAPACITOR (C) C13
CONNECTOR (J) J2
INDUCTOR (L) L7
TRANSISTOR (Q) Q5
RESISTOR (R) R26
VARISTOR (RV)
SWITCH (S)
TRANSFORMER (T)
INTEGRATED CIRCUIT (U) U3
SURGE PROTECTOR (SG) SG2
SIGNATURES DATE
DRAWN AWL 04/24/97
CHECKED
ENGRG
ISSUED
FILENAME
NEXT ASSY
SunTech Medical Instruments, Inc.
8917 Glenwood Avenue Raleigh, N.C. (919) 782-3005
SCHEMATIC
2120 ISOLATED ECG PWA
SIZE B FSCM NO. DWG NO. 92-0001-XX-SD
SCALE=NONE REV B SHEET 1 OF 2
REV CN DATE APPROVAL
A 970101 27 JAN 97 D. MCBEE
B 970401 04 MAR 97 D. MCBEE

APPENDIX 7 TANGO+ INTERNAL ECG PCB SCHEMATICS (Sheet 2)